(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 January 2002 (24.01.2002)

PCT

(10) International Publication Number
WO 02/06578 A1

(51) International Patent Classification[7]: D06H 5/00 // A41D 27/24, B05D 3/06, D05B 1/26

(21) International Application Number: PCT/US01/21479

(22) International Filing Date: 6 July 2001 (06.07.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/218,317 14 July 2000 (14.07.2000) US

(71) Applicant *(for all designated States except US)*: **NEXTEC APPLICATIONS, INC.** [US/US]; 2611 Commerce Way, Suite D, Vista, CA 92083 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **KULKARNI, Chidambar, L.** [US/US]; 5141 Montessa Street, San Diego, CA 92124 (US). **MAINVILLE, Michael, L.** [US/US]; 756 West College Street, Fallbrook, CA 92028 (US). **O'SULLIVAN, Edward, P., II** [US/US]; 17114 Bernardo Oaks Drive, San Diego, CA 92128 (US). **DUNCAN, Donald, P.** [US/US]; 4976 Sterling Grove Lane, San Diego, CA 92130 (US).

(74) Agent: **HEISEY, David, E.**; Lyon & Lyon LLP, 633 West Fifth Street, Suite 4700, Los Angeles, CA 90071-2066 (US).

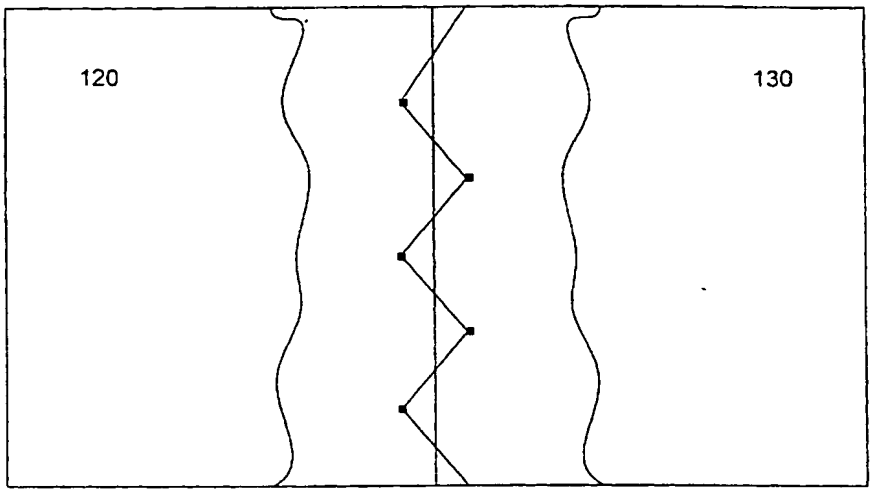
(81) Designated States *(national)*: CA, JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: FABRIC SEAM SEALING USING SEALANT



(57) Abstract: A method of seam sealing fabrics using spray for greater fluid-resistance includes placing a fabric having an existing seam (10) through feed rollers (80, 90) and spraying flowable sealant onto the existing seam (10). Atomized liquid silicone or other sealant flows out of a spray nozzle (50), expanding expands outwardly and resulting in a sprayed area (140) of uniform thickness in the middle and tapering out along the edges to form a smooth transition to the fabric. The use of atomized sprayed silicone shows great improvements in adhesive and waterproofing properties over prior art silicone tape sealing methods.

WO 02/06578 A1

PROCESS THIS APPLICATION AS A PCT INTERNATIONAL APPLICATION

TITLE OF THE INVENTION:

FABRIC SEAM SEALING USING SEALANT

RELATED APPLICATIONS

This application claims priority from provisional U.S. Application No. 60/218,317 filed on July 14, 2000.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the seam sealing of fabrics using a sealant, and more specifically to the seam sealing of fabrics using a silicone spray for greater fluid-resistance.

2. Background

The following description of the background of the invention is intended to aid in the understanding of the invention, but is not admitted to describe or constitute prior art to the invention.

Fabric to fabric joining is often carried out by overlapping fabrics, stitching the materials together and adhesively bonding them. With respect to the manufacture of waterproof fabric assemblies having stitched seams, it is often advantageous to seal the seams to preserve the waterproof integrity of the fabric. High performance products such as skiwear, rainwear, medical protective garments, wetsuits, tents, awnings, military garments and military protective garments require seam sealing to prevent water or any liquid from seeping around the folded fabric edge, or seeping through the thread hole or the thread itself. Typically, seams are

sealed using a sealing tape made of a fabric similar to the fabrics comprising the seam.

A variety of high surface energy sealing tapes having polyurethane, polyester or polyolefin adhesives are commercially available for seam sealing polyurethane, leather, vinyl-coated fabrics and other high performance fabrics. Fabrics may be treated with silicone in order to impart certain special performance properties. It is well known in the garment industry that silicone surfaces have low surface energies and, therefore, are not compatible with high surface energy sealing tapes. Even pressure sensitive silicone tapes are not capable of providing the necessary adhesion strength to survive laundering and autoclaving processes. Unfortunately, there is no tape technology commercially available that provides seam sealing of garments made from fabrics treated with silicones. Thus, there is a current need for a method of sealing seams, preferably one that is compatible with fabrics treated with silicone and capable of forming sufficiently strong adhesive bonds with silicone-treated fabrics so that the seal will be durable to the service conditions under which the product will be used.

SUMMARY OF THE INVENTION

One aspect of the present invention involves sealing the fabric seams or other material with a sealant by spraying a pressurized (e.g., atomized) liquid silicone for seam sealing garments made from silicone-treated fabrics. The use of atomized sprayed silicone shows improvements in adhesive and waterproofing properties over prior art silicone tape sealing methods.

Another aspect of the present invention involves seam sealing fabrics using spray for greater water-resistance includes placing a fabric having an existing seam through feed rollers or other drive mechanism (e.g., human hands), spraying atomized liquid silicone onto said existing seam to form a sprayed area on said existing seam and curing the sprayed silicone. The sprayed area is of uniform thickness in the middle while tapering out toward the sides. The tapered sides result in a smooth transition to the fabric forming an inconspicuous fabric seam having fewer unsightly bulges and creases than bulky seams produced by

prior art sealing tapes. Another advantage over prior art sealing tapes is that the resulting sealed seam is elastic and pliable so that it bends along with the fabric.

A further aspect of the present invention involves an apparatus for sealing a seam using atomized liquid silicone includes an aligning means for aligning a material having an existing seam, a spraying means for spraying atomized liquid silicone onto said existing seam to form a sprayed area of silicone on the existing seam and a curing means for curing the sprayed area of silicone. The aligning means may include feed rollers powered by a motor. By controlling the speed of the speed rollers, a user can control the thickness of sprayed silicone to be applied to an existing fabric seam. The spraying means may include a spray nozzle having a needle valve assembly which combines air with liquid silicone to form the atomized liquid silicone. The spray angle of the spray nozzle can be adjusted based on the type of seam being sealed.

The summary of the invention described above is non-limiting and other features and advantages of the invention will be apparent from the following description of the preferred embodiments, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 depicts a preferred embodiment of the present invention wherein atomized silicone is sprayed through a spray nozzle on top of an existing fabric seam to produce a sprayed area of silicone along the existing seam;

Figure 2 depicts the use of motorized feed rollers to control the alignment of a fabric in order to ensure accurate seam sealing of an existing seam;

Figure 3 depicts a butt seam having a zigzag stitch after being sealed using a preferred embodiment of the present seam sealing apparatus.

Figure 4 depicts the sprayed area formed after seam sealing a butt seam having a zigzag stitch.

Figure 5 depicts a double stitched Feld seam after being sealed using a preferred embodiment of the present seam sealing apparatus.

DETAILED DESCRIPTION OF THE INVENTION

The present invention features a spray technique using liquid silicone for seam sealing of garments made from silicone-treated fabrics. High performance products such as skiwear, rainwear, medical protective garments, wetsuits, tents, awnings, military garments and military protective garments require seam sealing to prevent liquid from seeping around the folded fabric edge, through the thread hole or the thread itself. Liquid silicones show improved adhesion characteristics over sealing tapes.

Referring to Figure1, silicone seam sealing can be accomplished by applying silicone over a silicone-treated fabric seam 10 of two abutting materials (20, 30). Preferably, the silicone is first atomized, then sprayed on top of the existing sewn seam 10. Although, the silicone may alternatively be painted onto the seam 10, a silicone spraying technique is preferred for maintaining a substantially uniform film thickness and film width with "feathered" edges. The feathered edges help provide a better appearance than taped seams and allows sealing of lighter weight fabrics that would be unsightly when sealed with tapes. In addition, spraying silicone into the holes or overlap areas of the seam 10 restores the water-resistant properties of the base material (20, 30).

Although silicone is used as the exemplary sealing media, the spray sealing technology taught by the present invention may be performed with other polymeric compositions wherein the adhesive and the adherend are of similar characteristics. For example, atomized liquid polyurethane can be used to seal a polyurethane-treated fabric seam of two abutting materials.

With further reference to Figure 1, a needle valve assembly 40 is employed to combine air with liquid silicone to form atomized liquid silicone. The atomized silicone is then sprayed through a spray nozzle 50 on top of an existing sewn fabric seam 10. The resulting flow of atomized silicone out of the spray nozzle 50 follows a conical or flat fan path 60, expanding outwardly from the nozzle 50. The conical path 60 of the silicone results in a sprayed area 70 that has a uniform thickness in the middle region and tapered edges that form a smooth transition to the abutting materials (20, 30). This smooth transition results in an inconspicuous fabric seam 10 having fewer unsightly bulges and creases than seams sealed with sealing tapes. In

addition, the resulting sealed seam 10 is elastic and pliable so that it bends along with the abutting materials (20, 30). In contrast, prior art sealing tapes are typically much less flexible and do not have tapered edges, which results in a noticeably bulky fabric seam.

Referring to Figure 2, a preferred apparatus and method of seam sealing fabrics treated with silicone is depicted. The method initially entails placing abutting materials (20, 30) having a seam 10 through feed rollers (80, 90) such that a stationary spray nozzle 50 sprays atomized liquid silicone onto the seam 10 after passing through the feed rollers (80, 90). Alternatively, seam sealing can be accomplished without the use of feed rollers (80, 90). For instance, a hand-held spray nozzle can be employed wherein the path of atomized liquid silicone spray is guided by a person holding a detached, manual spray nozzle. The spray may also be guided by a mechanical apparatus such as a robot. To accomplish a hand-held spray nozzle, the stationary spray nozzle 50 can easily be detached and the feed rollers (80, 90) simply not utilized. This technique is especially useful with respect to non-flat fabrics with curved seams which are not conducive to being fed through feed rollers and, therefore, require a human to direct the path of the silicone.

With further reference to Figure 2, the lower roller 90 is preferably a driven roller 90 powered by a motor 100. By contrast, the upper roller 80 is preferably a free roller 80 that rotates in a direction opposite of the lower, driven roller 90 as the fabric is fed through the two rollers (80, 90). The arrows depicted in Figure 2 indicate the direction of rotation of the feed rollers (80, 90). Functionally, the feed rollers (80, 90) help to ensure uniform speed and correct alignment of abutting materials (20, 30) and silicone spray. In addition, by varying the speed of the rollers (80, 90), the thickness of the sprayed silicone layer 70 may be adjusted. For instance, a reduction in roller speed will cause the sprayed layer 70 to be thicker. Alternatively, adjusting the spray parameters of the spray nozzle 50 can vary the thickness of the sprayed silicone layer 70.

Adjustment of the spray parameters may be necessary when sealing different types of seams. Various types of seams include, but are not limited to overlap seams, butt seams, prayer seams and flat Feld seams. One important spray parameter is the spray angle, which may be altered based on the type of seam that is

being sealed. Some seams display better waterproof qualities when sealed using a spray angle of 90 degrees such that the atomized silicone is sprayed straight down upon the fabric seam. However, other seams are better sealed when the silicone is sprayed onto the seam at an angle other than 90 degrees.

For instance, with reference to Figure 3, a butt seam 110 having a zigzag stitch with needle holes (150, 160) is depicted. This type of seam 110 is best sealed using a spray angle of 90 degrees such that the atomized silicone is sprayed straight down upon the fabric seam 110 of two abutting materials (120, 130). As illustrated in Figure 4, the silicone forms a sprayed area 140 of uniform thickness in the middle while tapering out toward the sides. The tapered sides result in a smooth transition to the abutting materials (120, 130), thereby forming an inconspicuous fabric seam 110 having fewer unsightly bulges and creases than bulky seams produced by prior art sealing tapes. Another advantage over prior art sealing tapes is that the resulting sealed seam 110 using the present invention is elastic and pliable so that it bends along with the abutting materials (120, 130). The resulting sprayed area 140 completely covers the existing seam 110 and the needle holes (150, 160), restoring the waterproof properties of the abutting materials (120, 130). In addition, some of the sprayed silicone actually seeps through the needle holes (150, 160) and seam 110. As a result, the needle holes (150, 160) and seam 110 are completely plugged such that liquid is unable to penetrate the entire seam area. The plugging of the needle holes (150, 160) is a result of wicking, whereby the sprayed liquid silicone seeps through the needle holes (150, 160) of the zigzag butt seam 110. By penetrating through the seam 110 and needle holes (150, 160), the sprayed silicone 140 forms a mechanically interlocking bond with the existing abutting materials (120, 130), further waterproofing the seam 110.

With reference to Figure 5, a double stitched Feld seam 200 with two overlapping materials (240, 250) is depicted which requires a particular spray angle for best results. This type of seam 200 is vulnerable to water penetration through both the needle holes (210, 220) at the top of the seam and through the seam fold at an opening 230 into the seam 200. In order to seal these vulnerable areas, a spray angle of less than 90 degrees is desirable, and approximately 60 degrees may be most effective. When the atomized silicone is sprayed onto the double stitched Feld

seam 200 at this angle, a sprayed area is formed which completely seals both vulnerable areas. A spray angle of 60 degrees is preferred so that the atomized sprayed silicone penetrates into the opening 230 of the seam 200, completely waterproofing the seam fold. In addition, wicking occurs through the needle holes (210, 220) at the top of the seam 200 such that the needle holes (210, 220) become completely plugged by the sprayed silicone. Wicking also occurs from the opening 230 between the two overlappped fabrics (240, 250) so that a very good, durable seal is formed. By penetrating through the seam opening 230 and needle holes (210, 220), the sprayed silicone forms a mechanically interlocking bond with the overlapping fabrics (240, 250), further waterproofing the seam 200.

As mentioned above, silicones have low surface energy and are not compatible with many materials such as polyurethane or polyester adhesives having higher surface energies. Even pressure sensitive tapes with silicone adhesives fail to improve adhesion due to their inability to mechanically or chemically interlock with the cured silicone on the fabric surface. However, the present invention takes advantage of the fact that liquid silicones show vastly improved adhesive qualities due to increased mechanical interlocking achieved with lower or controlled viscosity. Therefore, room temperature vulcanizing (RTV) silicones, high temperature platinum silicones and peroxide curable silicones are excellent seam sealants for silicone treated fabrics.

Some factors to be considered when selecting an ideal silicone adhesive are cure rate, shelf life and environmental conditions such as temperature and humidity. For example, RTV silicones applied over a fabric seam require moisture from the surrounding environment to cure and require several hours to complete the curing process. RTV silicones are not desirable in a production operation where a short curing time is necessary, but may be appropriate for some types of seams.

On the other hand, platinum and peroxide curable silicones are sensitive to temperature, and moisture does not promote curing. Therefore, by controlling heat, you can control the silicone curing mechanism of a platinum or peroxide curable silicone.

When selecting the silicone to be applied, the desired cure rate should be considered. Generally, moisture curable silicones cure slower than heat curable silicones and require moisture in the surrounding environment to cure. However, heat curable silicones with a platinum catalyst can be cured at a faster rate by applying heat. Regarding heat curable silicones, the cure rate depends on the amount of catalyst and type of inhibitor present in the system.

It will be readily apparent to one skilled in the art that varying substitutions and modifications may be made to the invention disclosed herein without departing from the scope and spirit of the invention.

The invention illustratively described herein suitably may be practiced in the absence of any element or elements, limitation or limitations which is not specifically disclosed herein. Thus, for example, in each instance herein any of the terms "comprising", "consisting essentially of" and "consisting of" may be replaced with either of the other two terms. The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention that in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by preferred embodiments and optional features, modification and variation of the concepts herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method of sealing a seam comprising the steps of:

aligning a material having an existing seam;

spraying sealant onto said existing seam to form a sprayed area of sealant on the existing seam; and

curing the sprayed area of sealant.

2. The method of claim 1, wherein the step of aligning the existing seam is accomplished using a set of feed rollers.

3. The method of claim 2, wherein said feed rollers are powered using a motor.

4. The method of claim 2, wherein the sealant flows through a spray nozzle.

5. The method of claim 4, wherein the sealant is silicone and wherein the spray nozzle includes a needle valve assembly which combines air with the sealant to form atomized liquid silicone.

6. The method of claim 4, wherein the spray angle of the spray nozzle is adjusted based on the type of seam being sealed.

7. The method of claim 6 wherein a spray angle of approximately 60 degrees is used to seal a double stitched Feld seam.

8. The method of claim 6 wherein a spray angle of approximately 90 degrees is used to seal a butt seam.

9. The method of claim 4, wherein the flow of sealant out of the spray nozzle follows a conical or flat pan path expanding outwardly from the spray nozzle.

10. The method of claim 1, wherein the sprayed area has a substantially uniform thickness in the middle and tapers out toward the edges.

11. The method of claim 10, wherein the thickness of the sprayed area can be adjusted by varying spray parameters.

12. The method of claim 11, wherein the spray parameters include feed roller speed and spray angle.

13. The method of claim 1, wherein the step of spraying sealant onto said existing seam causes wicking.

14. The method of claim 1, wherein the sealant is heat curable.

15. The method of claim 14, wherein said heat curable sealant contains a platinum catalyst for a faster curing rate.

16. The method of claim 14, wherein said heat curable sealant is a peroxide curable silicone.

17. The method of claim 1, wherein the sealant is a moisture curable RTV silicone.

18. The method of claim 4, wherein the sealant is polyurethane and wherein the spray nozzle includes a needle valve assembly which combines air with the sealant to form atomized liquid polyurethane.

19. An apparatus for sealing a seam comprising:
aligning means for aligning a material having an existing seam;
spraying means for spraying sealant onto said existing seam to form a sprayed area of sealant on the existing seam; and
curing means for curing the sprayed area of sealant.

20. The apparatus of claim 19, wherein the aligning means comprises a set of feed rollers.

21. The apparatus of claim 20, wherein said feed rollers are powered using a motor.

22. The apparatus of claim 19, wherein the spraying means includes a spray nozzle through which sealant flows.

23. The apparatus of claim 22, wherein the sealant is liquid silicone and the spray nozzle includes a needle valve assembly which combines air with the liquid silicone to form atomized liquid silicone.

24. The apparatus of claim 22, wherein the spray angle of the spray nozzle is adjusted based on the type of seam being sealed.

25. The apparatus of claim 24 wherein a spray angle of approximately 60 degrees is used to seal a double stitched Feld seam.

26. The apparatus of claim 24 wherein a spray angle of approximately 90 degrees is used to seal a butt seam.

27. The apparatus of claim 22, wherein the flow of sealant out of the spray nozzle follows a conical or flat pan path expanding outwardly from the spray nozzle.

28. The apparatus of claim 19, wherein the sprayed area has a substantially uniform thickness in the middle and tapers out toward the edges.

29. The apparatus of claim 28, wherein the thickness of the sprayed area can be adjusted by varying spray parameters.

30. The apparatus of claim 29, wherein the spray parameters include feed roller speed and spray angle.

31. The apparatus of claim 19, wherein spraying sealant onto said existing seam causes wicking.

32. The apparatus of claim 19, wherein the curing means includes heat.

33. The apparatus of claim 32, wherein the curing means is a heat curable silicone with a platinum catalyst for a faster curing rate.

34. The apparatus of claim 19, wherein the curing means is a peroxide curable silicone.

35. The apparatus of claim 19, wherein the curing means is a moisture curable RTV silicone.

36. The method of claim 22, wherein the sealant is polyurethane and wherein the spray nozzle includes a needle valve assembly which combines air with the sealant to form atomized liquid polyurethane.

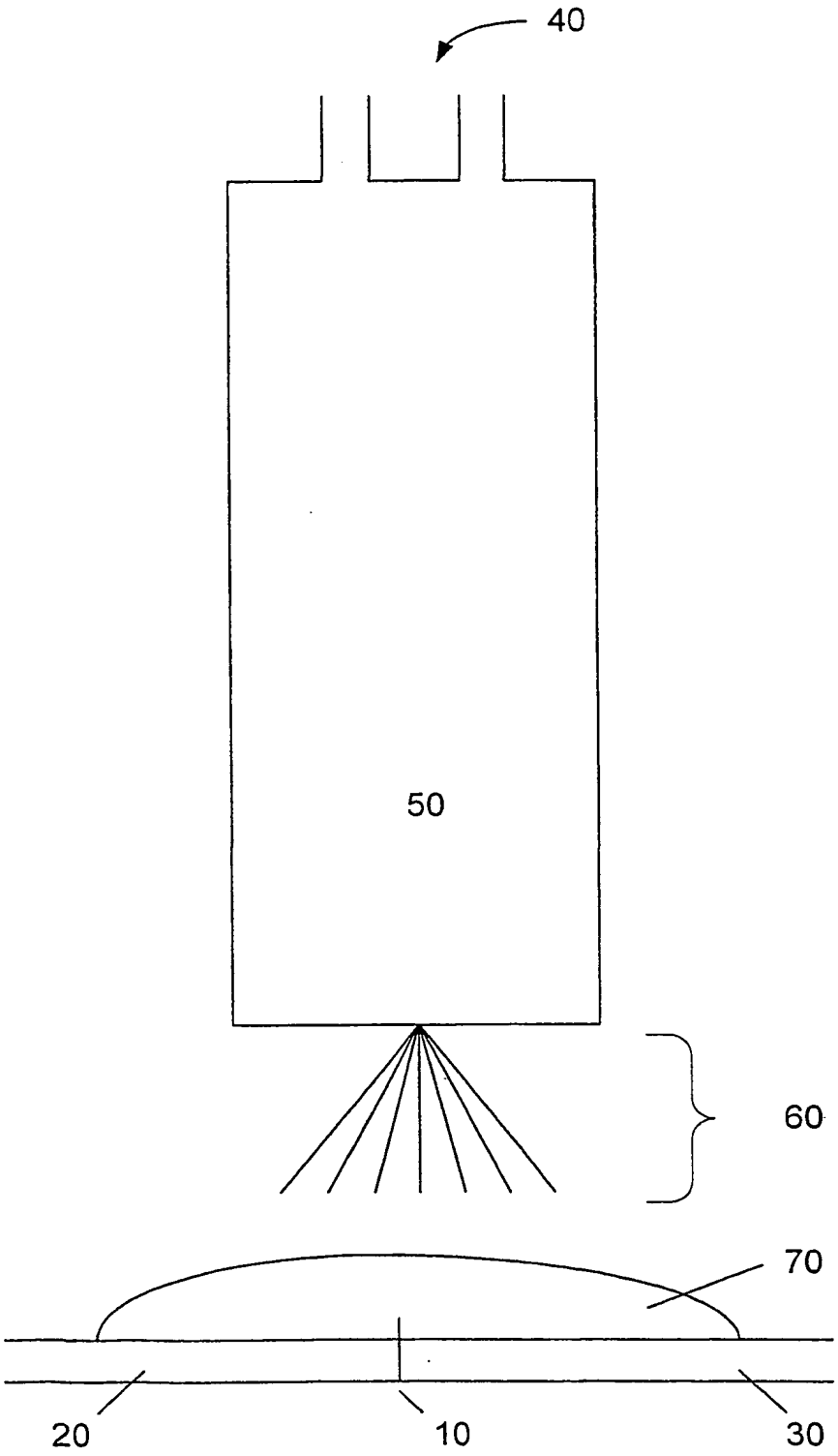


FIG. 1

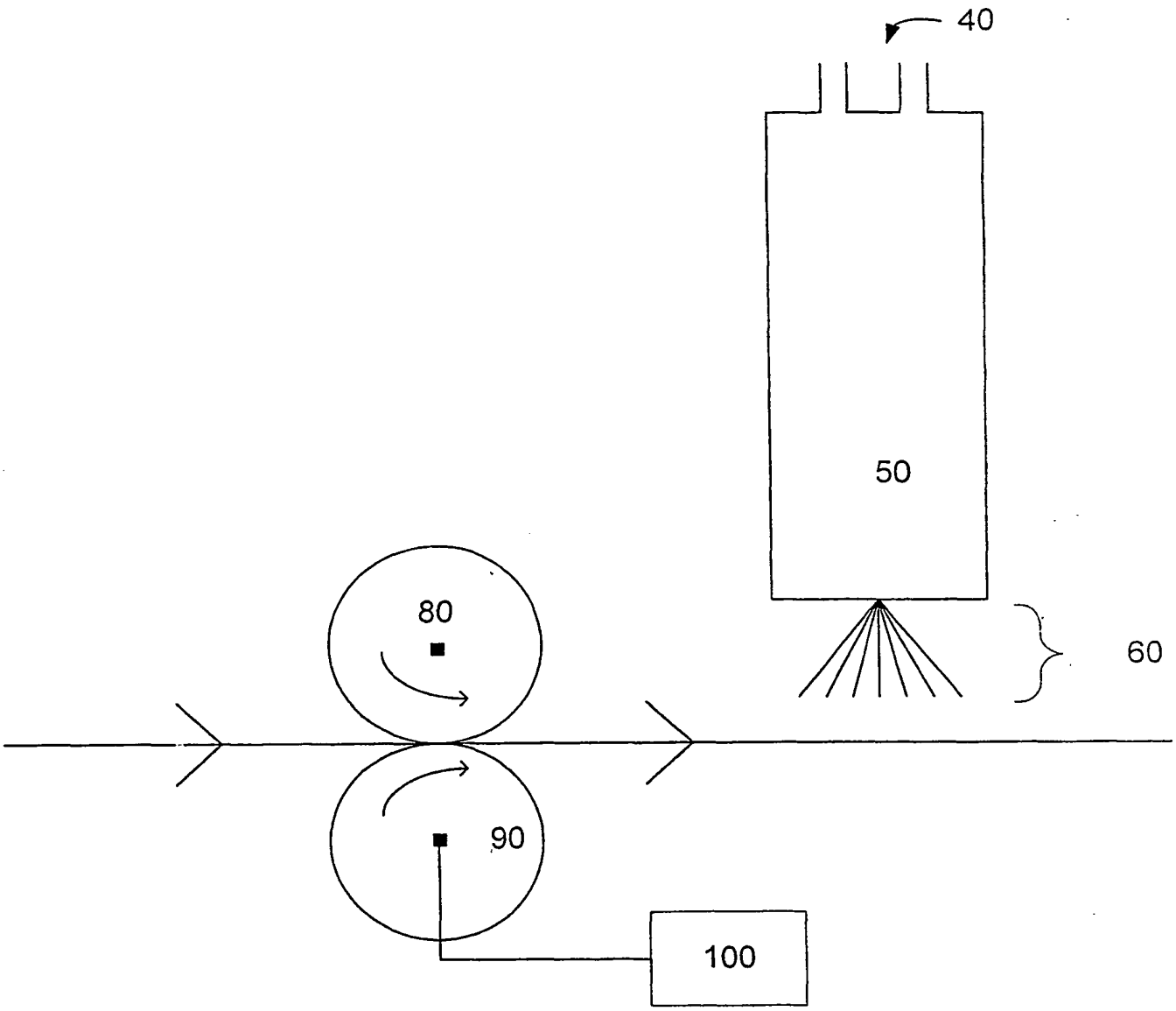


FIG. 2

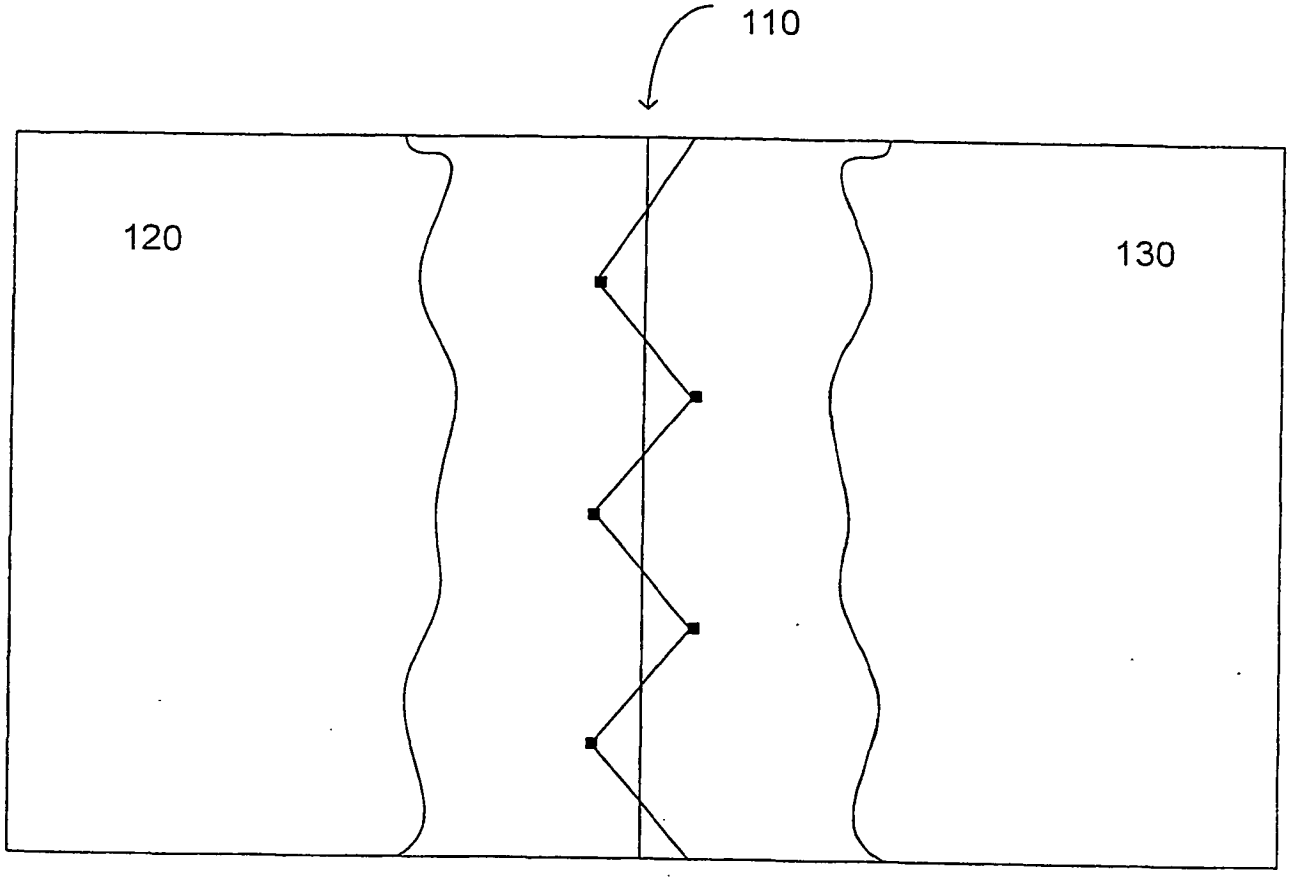


FIG. 3

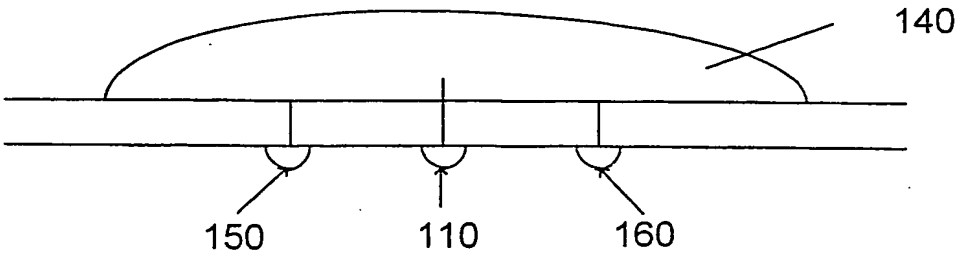


FIG. 4

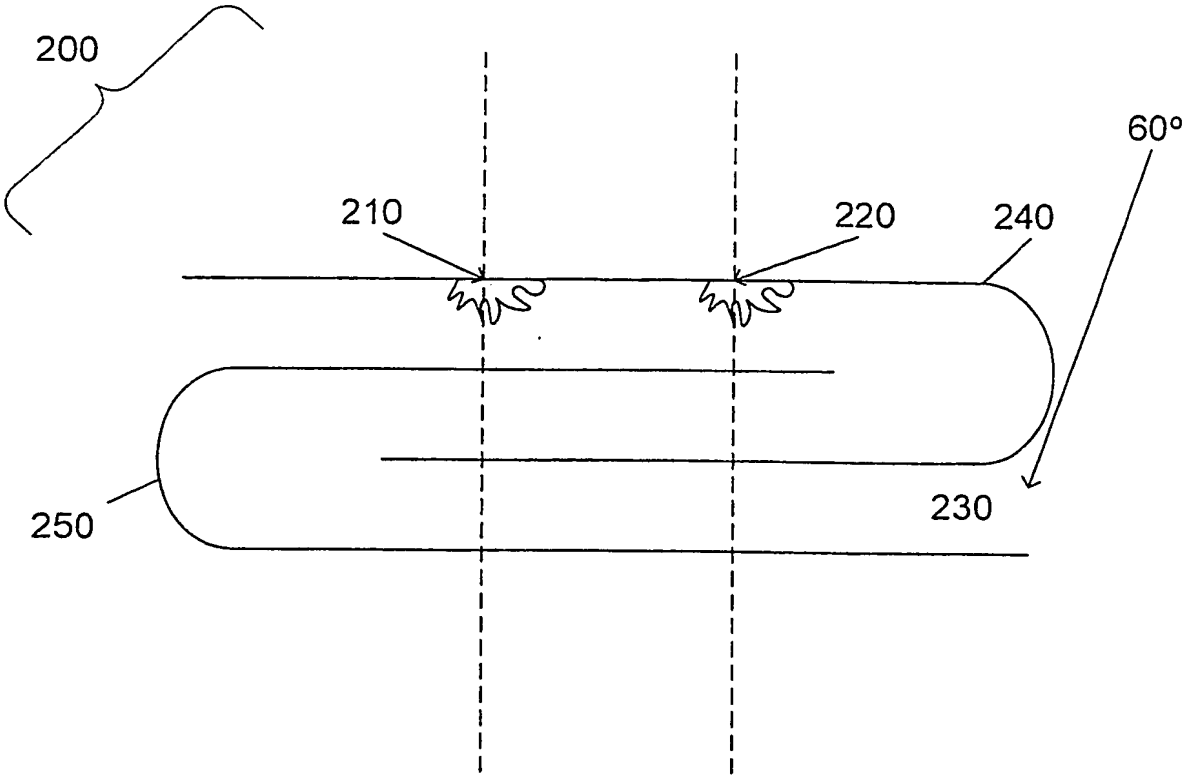


FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/21479

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D06H5/00 //A41D27/24,B05D3/06,D05B1/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B29C A41D D05B B29D B63C D06H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 604 876 A (ICI LTD;HAROLD SHEPHERD) 12 July 1948 (1948-07-12) page 4, line 28 - line 34; claim 1	1,14
A	GB 1 379 633 A (JELTEK LTD) 2 January 1975 (1975-01-02) page 1, line 14 - line 21	1,18
A	GB 2 071 564 A (CLARES CARLTON LTD) 23 September 1981 (1981-09-23) page 1, line 8 - line 15	1
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 03, 31 March 1999 (1999-03-31) & JP 10 317216 A (TOKUDA JOJI), 2 December 1998 (1998-12-02) abstract	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not consicered to be of particular relevance

"E" earlier document but published on or after the international filing cate

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 November 2001	08/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Carré, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

tional Application No
PCT/US 01/21479

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 295 493 A (SHOKICHI YAMAMOTO) 3 January 1967 (1967-01-03) figures	1-4,9, 19-22
A	US 5 582 949 A (BIGELOW RICHARD W ET AL) 10 December 1996 (1996-12-10) abstract; figure 5	1,10,19, 22,27,28
A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 094 (M-574), 25 March 1987 (1987-03-25) & JP 61 244529 A (YOSHIKAWA KOGYO KK), 30 October 1986 (1986-10-30) abstract	1,19,22, 27

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
../US 01/21479

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
GB 604876	A	12-07-1948	NONE		
GB 1379633	A	02-01-1975	NONE		
GB 2071564	A	23-09-1981	NONE		
JP 10317216	A	02-12-1998	NONE		
US 3295493	A	03-01-1967	NONE		
US 5582949	A	10-12-1996	NONE		
JP 61244529	A	30-10-1986	JP JP	1679659 C 3043055 B	13-07-1992 01-07-1991